

Kindergarten

Standard 1: Physical Science

Core Standard:

Observe, manipulate, sort and generate questions about objects and their physical properties.

K.1.1. Use all senses as appropriate to observe, sort and describe objects in terms of their composition and physical properties, such as size, color, and shape. Explain these choices to others and generate questions about the objects.

K.1.2 Identify possible uses for an object based on its properties and compare with other students' ideas.

Standard 2: Earth and Space Science

Core Standard:

Observe, record, and recognize patterns and generate questions about night/day and seasons.

K.2.1 Observe and record when the sun shines on different parts of the school building.

K.2.2 Describe and compare objects seen in the night sky and in the day sky.

K.2.3 Draw pictures and/or write words in a notebook to describe the weather changes from month to month and throughout the seasons.

Standard 3: Life Science

Core Standard:

Observe living organisms, compare and contrast their characteristics, and ask questions about them.

K.3.1 Observe and draw physical features of common plants and animals.

K.3.2 Describe and compare living animals in terms of shape, texture of body covering, size, weight, color, and the way they move.

K.3.3. Describe and compare living plants in terms of growth, parts, shape, size, color, and texture.

Process Standards

The Nature of Science

Students gain scientific knowledge by observing the natural and constructed world, performing and evaluating investigations and communicating their findings. These principles should guide student work and be integrated into the curriculum along with the content standards on a daily basis.

- Conduct investigations that may happen over time as a class, in small groups, or independently.
- Generate questions and make observations about natural processes.
- Make predictions based on observations.
- Discuss observations with peers and be able to support your conclusion with evidence.
- Make and use simple equipment and tools to gather data and extend the senses.
- Recognize a fair test.
- Use a scientific notebook to record predictions, questions and observations about data with pictures, numbers or in words.

The Design Process

As citizens of the constructed world students will participate in the design process. Students at this grade level will learn to use materials and tools safely and employ the basic principles of the engineering design process in order to find solutions to problems.

- Identify the goal of a design for a real-world problem that needs a solution
- Select and use materials based on their physical properties to develop a solution that will meet the goal
- Draw and plan the solution in a notebook
- Create the solution
- Evaluate and test how well the solution meets the goal.
- Document the solution with drawings including labels.

Grade 1

Standard 1: Physical Science

Core Standard:

Describe objects in terms of the materials that compose them and their physical properties.

- 1.1.1 Use all senses as appropriate to identify the component parts of objects and the materials from which they are made.
- 1.1.2 Characterize materials as solid or liquid, investigate their properties, record observations and explain the choice to others based on evidence (e.g. physical properties).

Standard 2: Earth and Space Science

Core Standard:

Observe, describe, and ask questions about soil components and properties.

- 1.2.1 Observe and compare properties of sand, clay, and humus. Look for evidence of sand, clay and humus as components of soil samples.
- 1.2.2 Choose, test, and use tools to separate soil samples into component parts.
- 1.2.3 Observe a variety of soil samples and describe in words and pictures the soil properties in terms of color, particle size and shape, texture, and recognizable living and nonliving items in the soil.
- 1.2.4 Observe over time the effect of organisms such as earthworms in the formation of soil from dead plants. Discuss the importance of earthworms in soil.

Standard 3: Life Science

Core Standard:

Observe, describe and ask questions about living things and their relationship to their environment.

- 1.3.1 Classify living organisms as having or not having specific external structures and describe how those structures help them live in different environments.
- 1.3.2 Observe closely over a period of time, draw and write about organisms in different habitats such as terrariums, aquariums, lawns, and trees.

1.3.3 Observe and explain that plants and animals both need to take in water, animals need to take in food, and plants need light.

1.3.4 Observe and describe that animals may use plants for shelter and food.

1.3.5 Describe how animal's habitats meet their needs for food, water, and shelter.

Standard 4: Science, Engineering and Technology

Core Standard:

Determine properties of natural and man-made materials and their best uses.

1.4.1 Compare an animal's habitat to the habitat of another animal in terms of materials and tools used to build each shelter.

1.4.2 Use all senses as appropriate to sort objects as being composed of materials that are naturally-occurring or human-made, and explain choices to others based on evidence.

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Indiana's Revised Academic Standards for Science – Draft 1

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Grade 2

Standard 1: Physical Science

Core Standard:

Observe and describe that the properties of materials can change, but not all materials respond in the same way to the same action.

Core Standard:

Observe and describe how the motion of an object changes when a force is applied.

- 2.1.1. Observe and describe ways in which the properties of a sample of water (including amount) change or stay the same as it is heated and cooled and enters different states (i.e., liquid, solid, gas).
- 2.1.2. Predict the result of combining solids and liquids in pairs. Mix, observe, gather, record and discuss evidence that the result may be a material with different properties than the original materials.
- 2.1.3. Predict and experiment with methods (e.g. sieving, evaporation) to separate solids and liquids based on their physical properties.
- 2.1.4 Observe, sketch, demonstrate, and compare how objects can move in different ways (straight, zig-zag, back-and-forth, rolling, fast and slow).
- 2.1.5 Describe the position of an object relative to a point of reference (background or another object).
- 2.1.6 Observe, sketch, demonstrate, and compare how force (push or pull) changes the motion of objects.

Standard 3: Earth Science

Core Standard:

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Day to day and over the seasons observe, measure, record, recognize patterns and ask questions about features of weather.

- 2.2.1 Construct and use tools to observe and measure weather conditions such as precipitation, temperature, wind speed and direction.
- 2.2.2 Experience and describe wind as moving air that surrounds us.
- 2.2.3 Chart or graph weather observations such as cloud cover, cloud type, and type of precipitation on a daily basis.
- 2.2.4 Ask questions about charted observations and graphed data. Identify the patterns and cycles in day-to-day weather as well as seasonal weather data in terms of temperature and rainfall/snowfall amounts.
- 2.2.5 Ask questions and design class investigations to investigate the effect of the sun heating the surface of the earth.
- 2.2.6 Investigate the day/night cycle by observing and drawing the length and direction of shadows cast by the sun.
- 2.2.7 Research, report, and practice severe weather safety procedures.

Standard 3: Life Science

Core Standard:

Observe describe, and ask questions about how organisms change their forms and behavior as part of their life cycle.

- 2.3.1 Observing closely over a period of time, record in pictures and words the changes in an organism throughout its life cycle and how it meets its needs.
- 2.3.2 Use measurements such as length and time intervals to record the changes throughout the life cycle of an organism.

Standard 4: Science, Engineering and Technology

Core Standard:

Describe how technology changes to meet needs people have identified.

2.4.1 Identify parts of the human body as tools such as hands for grasping and teeth for cutting and chewing.

2.4.2 Identify a need and design a simple tool to meet that need.

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Grade 3

Standard 1: Physical Science

Core Standard:

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Observe and describe that sound is produced by vibrations.

- 3.1.1 Create sounds using different materials, objects and techniques; record; discuss and share results.
- 3.1.2 Experiment with changing pitch (by changing the rate of vibration) and the loudness of sound.
- 3.1.3 Observe that sound moves through solids, liquids and gases.

Standard 2: Earth Science

Core Standard:

Observe, describe, and identify rocks and minerals by their unique properties.

- 3.2.1 Sort rock samples by size using simple tools such as sieves into categories including boulders, pebbles, sand, and silt.
- 3.2.2 Observe the detailed characteristics of rocks and minerals and identify rocks as being composed of different combinations of minerals.
- 3.2.3 Observe, classify, and identify minerals, for example quartz, mica, fluorite, and pyrite, by their physical properties of hardness, color, luster, and streak.
- 3.2.4 Observe fossils and describe how they provide evidence about the plants and animals that lived long ago and the nature of the environment at that time.

Standard 3: Life Science

Core Standard:

Observe, describe, and ask questions about plant growth and development.

- 3.3.1 Take, record, and display in graphs, metric measurements of plant growth over time.
- 3.3.2 Observe and identify the common structures of a plant including roots, stems, leaves, flowers, fruits, and seeds, and describe their functions.
- 3.3.3 Generate a researchable question about a factor that might influence plant growth and/or development and design a fair test to investigate the question.

Standard 4: Science, Engineering and Technology

Core Standard:

Design a product as a solution to a real world problem.

3.4.1 Choose and use appropriate units and tools to estimate and measure length, mass and temperature in metric units.

3.4.2 Engage in the entire engineering design process to design a solution to a real world problem.

Process Standards

The Nature of Science

Students gain scientific knowledge by observing the natural and constructed world, performing and evaluating investigations and communicating their findings. These principles should guide student work and be integrated into the curriculum along with the content standards on a daily basis.

- Make predictions and formulate testable questions.
- Design a fair test.
- Plan and carry out investigations as a class, in small groups or independently, often over a period of several class lessons.
- Perform investigations using appropriate tools and technology that will extend the senses.
- Use measurement skills and apply appropriate units when collecting data.
- Test predictions with multiple trials.
- Keep accurate records in a notebook during investigations and communicate findings to others using graphs, charts, maps and models through oral and written reports.
- Identify simple patterns in data and propose explanations to account for the patterns.
- Compare the results of an investigation with the prediction.

The Design Process:

As citizens of the constructed world students will participate in the design process. Students at this grade level will learn to use the design process to create a solution to a problem.

- Identify who needs the design
- Evaluate and test design using measurement
- Present evidence using mathematical representations (graphs, data tables)
- Redesign based on evidence
- Document the design so that it can be replicated by others

Grade 4

Standard 1: Physical Science

Core Standard:

Design and assemble electric circuits that provide a means of transferring energy.

- 4.1.1 Construct a complete circuit through which an electrical current can pass.
- 4.1.2 Experiment with materials to identify conductors and insulators of electricity.
- 4.1.3 Demonstrate that energy transferred by electricity can produce heat, light, and sound.

Standard 2: Earth Science

Core Standard:

Observe, describe, and ask questions about ways that the shape of the land changes.

- 4.2.1 Demonstrate and describe how smaller rocks come from the breakage and weathering of larger rocks.
- 4.2.2 Demonstrate and describe how waves, wind, water and glacial ice shape and reshape earth's land surface by the erosion of rock and soil in some areas and depositing them in other areas.
- 4.2.3 Demonstrate and describe how earthquakes, volcanoes, and landslides suddenly change the shape of the land.

Standard 2: Life Science

Core Standard:

Observe, describe, and ask questions about structures of organisms that affect their growth and survival.

- 4.3.1 Observe and describe how offspring are very much, but not exactly, like their parents or one another.
- 4.3.2 Observe, compare, and record the physical characteristics of live plants or animals from widely different environments, and describe how each is adapted to its environment.

4.3.3 Design an investigation to explore how organisms meet some of their needs by responding to information from the environment.

4.3.4 Describe a way that a given plant or animal might adapt to changes as the result of human impact on the environment.

Standard 4: Science, Engineering and Technology

Core Standard:

Design a moving product and measure its motion.

4.4.1 Investigate the properties of objects (mass, surface texture, shape) and forces (magnets, friction, and gravity) that affect their motion.

4.4.2 Make appropriate measurements to compare the speed of objects in terms of distance traveled in a given amount of time or time to travel a given distance.

4.4.3 Investigate that changes in speed or direction are caused by forces; the greater the force exerted on an object, the greater the change.

4.4.4 Engage in the entire engineering design process to design a real world solution to a problem in the context of motion.

Process Standards

The Nature of Science

Students will understand that scientific knowledge can be gained from observing the natural and constructed world performing and evaluating investigations and communicating their findings. Student work should align with this process of science and be guided by these principles that are integrated into the curriculum on a daily basis.

- Formulate questions that can be tested.
- Design a fair test.
- Plan and carry out investigations as a class, in small groups or independently often over a period of several class lessons.
- Select and use appropriate tools and technology in order to extend the senses in making observations.
- Use appropriate measurement skills to collect data.
- Keep accurate records during experimentation in a notebook.
- Recognize patterns in data and use data to create reasonable explanations for the results of an investigation.

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- Record data and communicate evidence-based findings to others using graphs, charts, maps and models through oral and written reports.
- Compare the results of an experiment with the prediction.
- Conduct multiple trials to test a prediction.

The Design Process:

As citizens of the constructed world students will participate in the design process. Students at this grade level will learn to use the design process to create a solution to a problem.

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- Evaluate and test design using measurement
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- Redesign based on evidence
- Document the design so that it can be replicated by others

Grade 5

Standard 1: Physical Science

Core Standard:

Describe the properties of weight and volume and measure weight and volume.

Core Standard:

Investigate how the weight of an object changes with melting, freezing and combining.

- 5.1.1 Describe and measure two of the properties of matter: volume and weight.
- 5.1.2 Demonstrate that regardless of how parts of an object are assembled, the weight of the whole object is identical to the sum of the weight of the parts, but the volume can differ.
- 5.1.3 Determine if matter has been added or lost by comparing weights when melting, freezing, or dissolving a substance.
- 5.1.4 Observe, describe and record how different quantities of starting materials will result in products with different properties.

Standard 2: Earth Science

Core Standard:

Observe, describe, and ask questions about patterns in the sun- moon-earth system.

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- 5.2.1 Recognize that the earth is part of a system called the solar system that includes the sun, moon, seven other planets and their moons.
- 5.2.2 Observe and use pictures to record how the sun appears to move across the sky in the same general way everyday but it appears to rise and set in different places as the seasons change.
- 5.2.3 In monthly intervals observe and draw the length and direction of shadows cast by the sun. Use the recorded data as evidence to explain how shadows are affected by the relative position of the earth and sun.
- 5.2.4 Use a calendar to record observations of the shape of the moon over a month. Based on the observations describe patterns in the moon cycle.

Standard 3: Life Science

Core Standard:

Observe, describe, and ask questions about how changes in one part of an ecosystem create changes in other parts of the ecosystem.

- 5.3.1 Observe and classify common Indiana organisms such as oak trees, grass, squirrels, birds, and earthworms as producers, consumers, decomposers, predator and prey.
- 5.3.2 Investigate the action of different decomposers.

Standard 4: Science, Engineering and Technology

Core Standard:

Design a prototype that replaces a function of a human body part and evaluate using selected criteria.

- 5.4.1 Investigate technologies that mimic human or animal muscular skeletal systems to meet a need.
- 5.4.2 Engage in the entire engineering design process to design a real world solution to a problem in the context of muscular skeletal body systems.

Process Standards

The Nature of Science

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Students will understand that scientific knowledge can be gained from observing the natural and constructed world performing and evaluating investigations and communicating their findings. Student work should align with this process of science and be guided by these principles that are integrated into the curriculum on a daily basis.

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- Design a fair test.
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- Use appropriate measurement skills to collect data.
- Keep accurate records during experimentation in a notebook.
- Recognize patterns in data and use data to create reasonable explanations for the results of an investigation.
- Record data and communicate evidence-based findings to others using graphs, charts, maps and models through oral and written reports.
- Compare the results of an experiment with the prediction.
- Conduct multiple trials to test a prediction.

The Design Process:

As citizens of the constructed world students will participate in the design process. Already possessing a natural curiosity, students at this grade level will learn to use the design process to create a solution to a problem.

- Identify who needs the design
- Evaluate and test design using measurement
- Present evidence using mathematical representations (graphs, data tables)
- Redesign based on evidence
- Document the design so that it can be replicated by others

Grade 6

Standard 1: Physical Science

Core Standard

Describe that all objects and substances in the natural world are composed of matter in different states with different properties.

Core Standard

Understand there are different forms of energy with unique characteristics.

- 6.1.1 Explain that all matter is made up of atoms.
- 6.1.2 Understand that atoms of any element are similar in structure (electron, proton, neutron), but are different from atoms of other elements.
- 6.1.3 Explain how atoms join together to form molecules and compounds.
- 6.1.4 Explain using drawings and models that matter exists in several different states (solid, liquid and gas) determined by the movement and position of its atoms or molecules.
- 6.1.5 Explain that all matter is composed of one or more of approximately one hundred elements organized on the periodic table based on their physical and chemical properties.
- 6.1.6 Explain that when matter changes state, the atoms and molecules are not changed in structure.
- 6.1.7 Compare and contrast potential energy and kinetic energy and identify how they are related.
- 6.1.8 Explain that energy is a property of many substances and is associated with heat, light, electricity, mechanical motion, sound, and chemical reactions.
- 6.1.9 Explain that energy can be transferred in predictable ways.

Standard 2: Earth and Space Science

Core Standard

Understand the relationships between celestial bodies and the force that keeps them in regular and predictable motion.

- 6.2.1 Demonstrate how the position, size and relationship of the earth, moon and sun and to one another cause day and night, solar and lunar eclipses and phases of the moon.
- 6.2.2 Compare and contrast the planets of the solar system with regard to their size, composition, distance from sun, surface features and ability to support life.
- 6.2.3 Recognize that gravity is a force that keeps celestial bodies in regular and predictable motion, holds objects to earth's surface, and is responsible for tidal patterns.
- 6.2.4 Demonstrate that the seasons in both hemispheres are the result of the tilting of the earth on its axis which in turn causes changes in sunlight intensity and length of day.

Standard 3: Life Science

Core Standard

Describe that all organisms, including humans, are part of complex relationships found in all biomes (freshwater, marine, forest, desert, grassland, tundra).

Core Standard

Understand that the major source of energy for ecosystems is the sun.

- 6.3.1 Describe specific relationships (predator/prey, consumer/producer or parasite/host) between organisms.
- 6.3.2 Describe how changes in a habitat are beneficial or detrimental to the survival of native plants and animals.
- 6.3.3 Describe how biotic and abiotic factors can limit the number of organisms that an ecosystem can support.
- 6.3.4 Describe the positive and negative impacts of human activity on ecosystems.
- 6.3.5 Compare and contrast how plants (producers/autotrophs) and animals (consumers/heterotrophs) obtain energy for life.
- 6.3.6 Describe how energy from the sun is used by plants to make sugar (glucose) by the process of photosynthesis and can be used immediately, incorporated into the plant's cells, or stored for later use.
- 6.3.7 Describe how consumers/heterotrophs use the energy stored in producers/autotrophs to grow and function.

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- Collect quantitative data with appropriate tools or technologies and use appropriate units to label numerical data.
- Incorporate variables that can be changed, measured or controlled.
- Use the principles of accuracy and precision when making measurements.
- Test predictions with multiple trials.
- Keep accurate records in a notebook during investigations and communicate findings to others using graphs, charts, maps and models through oral and written reports.
- Analyze data and use it to identify patterns and make inferences based on these patterns.
- Evaluate possible causes for differing results (valid data).
- Compare the results of an experiment with the prediction.

Grade 7

Standard 1: Physical Science

Core Standard

Explain that energy cannot be created or destroyed but only changed from one form into another or transferred from place to place.

Core Standard

Understand forces as they apply to nature and machines.

- 7.1.1 Explain that when energy is transferred from one system to another, the quantity of energy does not change.
- 7.1.2 Describe the transfer of energy from place to place through radiation, convection and conduction
- 7.1.3 Recognize and explain different ways of obtaining, transforming, and distributing energy have different environmental consequences.
- 7.1.4 Explain how light, sound and other waves have energy and how they interact with different materials.
- 7.1.5 Describe how forces between objects can act at a distance, such as magnetic, electrical or gravitational forces, or when objects are in direct contact.
- 7.1.6 Explain that the forces acting on an object can change its position, direction of motion, and speed.

- 7.1.7 Explain that forces have magnitude and direction and those forces can be added to reflect the sum of all forces acting on an object.

Standard 2: Earth and Space Systems

Core Standard

Describe how earth processes have shaped the topography of the earth and have made it possible to measure geological time.

- 7.2.1 Describe that the earth is a layered structure composed of lithospheric plates, a mantle and a dense core.
- 7.2.2 Explain the vastness of geologic time and recognize that it is measured in eras and epochs.
- 7.2.3 Explain how convection currents in the mantle cause lithospheric plates to move causing fast changes like earthquakes and volcanic eruptions, and slow changes like creation of mountains and formation of new ocean floor.
- 7.2.4 Describe the origin and physical properties of igneous, metamorphic and sedimentary rocks and how they are related through the rock cycle.
- 7.2.5 Describe soil characteristics and how they are influenced by the process of soil formation, bacteria, fungi, insects, and other organisms.
- 7.2.6 Use geological features such as karst topography and glaciation to explain how earth processes have shaped the land.
- 7.2.7 Compare and contrast fossils with living organisms in a given location to explain how earth processes have changed environments over time.

Standard 3: Life Science

Core Standard

Understand the cellular structure of living organisms, from single-celled to multicellular.

- 7.3.1 Explain that the fundamental unit of life is a single cell and all the basic functions of an organism are carried out within that cell.
- 7.3.2 Explain that a cell's structure is reflected in its function.
- 7.3.3 Compare and contrast the structure of plant and animal cells, including organelles.

- 7.3.4 Explain that most cells continually divide to make more cells and, in multicellular organisms, cells divide for growth and repair.
- 7.3.5 Describe the hierarchical organization of multicellular organisms and how cells, tissues, organs and organ systems work cooperatively within an organism.
- 7.3.6 Describe how various organs and tissues serve the needs of cells for nutrient and oxygen delivery and waste removal.

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- Use the principles of accuracy and precision when making measurements.
- Test predictions with multiple trials.
- Keep accurate records in a notebook during investigations and communicate findings to others using graphs, charts, maps and models through oral and written reports.
- Analyze data and use it to identify patterns and make inferences based on these patterns.
- Evaluate possible causes for differing results (valid data).
- Compare the results of an experiment with the prediction.

Grade 8

Standard 1: Physical Science

Core Standard

Describe how atomic structure determines chemical properties and how atoms and molecules interact.

- 8.1.1 Explain that chemical properties of substances are based on the arrangements of atoms in compounds and molecules.
- 8.1.2 Describe the structure of an atom and relate the position of electrons with how that atom interacts with other atoms.
- 8.1.3 Explain that chemical changes occur when substances are mixed and form one or more different substances, whose physical and chemical properties are different from the reactants.
- 8.1.4 Demonstrate that in a chemical change, the number and kinds of atoms are in the reactants are the same as the products and that mass is conserved.

Standard 2: Earth and Space Systems

Core Standard

Explain how the water cycle and air movement are caused by differential heating of air, land, and water and how these affect weather and climate.

Core Standard

Understand that natural and human events change the environmental conditions on the earth.

- 8.2.1 Recognize and demonstrate how the sun's energy drives convection which results in the water cycle, ocean currents and weather patterns.
- 8.2.2 Demonstrate that water moves through the earth's crust, atmosphere, and oceans in a cyclic way.
- 8.2.3 Describe the causes and characteristics of ocean currents and identify their effect on weather patterns.
- 8.2.4 Describe the physical and chemical composition of the atmosphere and its influence on the conditions necessary for Indiana weather and weather-related events such as tornados, lake effect snow, blizzards, thunderstorms, and flooding.
- 8.2.5 Identify, explain, and discuss some effects human activities have on the biosphere, such as air, soil, light, noise and water pollution.
- 8.2.6 Understand and explain that Earth's resources, such as fresh water, air, soil, fossil fuels and trees, are finite and explain how recycling, reducing consumption and the development of alternatives can reduce the rate of their depletion.

- 8.2.7 Explain that human activities have drastically changed the environment and have affected the capacity of the environment to support native species and explain current efforts to reduce and eliminate these impacts and encourage sustainability.

Standard 3: Life Science

Core Standard

Understand the predictability of characteristics being passed from parents to offspring.

Core Standard

Explain how a particular environment selects for traits that increase survival and reproduction by individuals bearing those traits.

- 8.3.1 Understand and explain that the information passed from parents to offspring is transmitted by chromosomes that are made of deoxyribonucleic acid (DNA).
- 8.3.2 Differentiate between inherited traits and physical and behavioral traits that are acquired or learned.
- 8.3.3 Compare and contrast sexual and asexual reproduction.
- 8.3.4 Recognize and explain that small genetic differences between parents and offspring can accumulate in successive generations so that descendants may be different from their ancestors.
- 8.3.5 Explain how sexual reproduction introduces increased diversity in traits within a population and confers a selective advantage for survival and reproduction.
- 8.3.6 Describe how environmental changes can result in extinction of a species.
- 8.3.7 Recognize and describe that new varieties of organisms have come about from selective breeding and genetic engineering.

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- Keep accurate records in a notebook during investigations and communicate findings to others using graphs, charts, maps and models through oral and written reports.
- Analyze data and use it to identify patterns and make inferences based on these patterns.
- Evaluate possible causes for differing results (valid data).
- Compare the results of an experiment with the prediction.

Integrated Chemistry and Physics

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Standard 1: Motion and Energy of Macroscopic Objects

Core Standard

Describe and explain the motion of macroscopic objects in terms of Newton's Laws and use the concepts of kinetic and potential energy to describe motion.

- ICP.1.1 Measure the motion of objects to understand the relationships between distance, velocity, and acceleration.
- ICP.1.2 Describe and apply Newton's three laws of motion. By experimentation, determine the relationships among the variables in Newton's laws.
- ICP.1.3 Describe how Newton's Law of Universal Gravitation explains the motions of objects on earth and space.
- ICP.1.4 Describe the kinetic and potential energies of macroscopic objects, and use measurements to develop an understanding of these forms of energy.

Standard 2: Mechanical Energy and Propagation of Energy by Waves

Core Standard

Explain that waves transmit energy, come in two forms, transverse and longitudinal, and occur throughout nature.

- ICP 2.1 Identify properties of objects that vibrate, using Newton's laws to understand the motion. Understand that vibrating objects create mechanical waves.
- ICP.2.2 Identify properties of waves including frequency, wavelength, amplitude, energy, and wave speed.
- ICP 2.3 Describe how energy is propagated by waves without the transfer of mass using examples such as surf, tsunamis, earthquakes, and sound waves.
- ICP.2.4 Apply the properties of waves to wave phenomena including reflection, and refraction, as well as the transmission and loss of energy.

Standard 3: Properties of Matter: Macroscopic as a Model for Microscopic

Core Standard

Understand how the energies and motions of atoms and molecules at the microscopic level can be used to understand and predict the macroscopic properties of matter of gases, liquids and solids.

- ICP.3.1 Describe how we use macroscopic properties of matter to model microscopic processes.
- ICP.3.2 Study the characteristics of solids, liquids, and gases and their changes of state and interpret them in terms of a molecular model which describes their energies and motions.
- ICP 3.3 Understand that thermal energy and temperature are related to the microscopic motions of atoms and molecules.
- ICP.3.4 Understand how the microscopic kinetic molecular theory, explains observations of macroscopic gas behavior in terms of temperature, volume, pressure, and the number of particles (using the mole concept).

Standard 4: Energy Transport

Core Standard

Describe how vibrations and waves transport energy.

- ICP.4.1 Using conservation of energy, calculate the thermal energy released or absorbed by an object and distinguish between exothermic and endothermic changes.
- ICP.4.2 Differentiate between conduction, convection, and radiation and identify them as types of energy transfer.
- ICP.4.3 Explain that electrons can absorb energy and release that energy, and that electrons in atoms do this at specific energies.
- ICP.4.4 Describe the relationships between velocity, frequency, wavelength, and energy in electromagnetic waves. Describe the regions of the electromagnetic spectrum.
- ICP 4.5 Understand that from diffraction we know that visible light is an electromagnetic wave.

Standard 5: Chemical Energy, Reactions, and Bonding

Core Standard

Describe how energy is produced in chemical reactions.

- ICP.5.1 Recognize and describe physical properties of matter and use these to differentiate between pure substances and mixtures.
- ICP 5.2 Use the periodic table to understand important patterns in properties of pure substances.
- ICP.5.3 Use molar mass to relate number of moles and mass of a substance.
- ICP.5.4 Using conservation principles write and balance chemical equations.
- ICP.5.5 Identify key indicators of a chemical change and classify simple types of chemical reactions. Differentiate between covalent and ionic bonding, write formulas for and name compounds of each type.
- ICP.5.6 Explain that in chemical reactions chemical energy is converted to other into other forms such as thermal energy, light, and sound.

Standard 6: Electrical Energy Propagation and Magnetism

Core Standard

Describe how the movement and transfer of charged particles results in the transfer of electrical energy.

- ICP.6.1 Explain that static electricity is the transfer of charge from one object to another following the law of conservation of charge.
- ICP.6.2 Using the examples of batteries and electrolysis, explain the relationship between chemical reactions and electrical energy.
- ICP.6.3 Define and describe the relationships between voltage, current, resistance and power.
- ICP.6.4 Describe the differences in current flow in parallel and in series circuits.
- ICP.6.5 Explain that some objects exert magnetic forces with no direct contact.
- ICP.6.6 Using the examples of motors and generators, explain that electrical energy can be transformed into mechanical energy and vice versa.

Standard 7: Nuclear Energy (fission/fusion)

Core Standard

Describe how the stability of nuclei in terms of the binding energies of their constituent protons and neutrons explains the energy production processes of fission and fusion.

- ICP.7.1 Demonstrate how historical models and experiments supported our development of and current understanding of the atom and its nucleus.
- ICP.7.2 Differentiate between protons, neutrons, and electrons and determine the number of these subatomic particles in each atom.
- ICP.7.3 Understand that the stability of nuclei depends on the numbers of neutrons and protons.
- ICP.7.4 Understand that fission results from large, less stable nuclei decomposing to form smaller, more stable nuclei.
- ICP.7.5 Understand that fusion results from small, less stable nuclei combining to form larger, more stable nuclei.
- ICP.7.6 Describe the three forms of radiation produced when more excited nuclei decay to more stable ones. Distinguish radiation from radioactive materials.
- ICP 7.7 Relate the fission process to the human development and use of the fission process in war (uncontrolled) and in peace (controlled).
- ICP 7.8 Understand that the energy radiated from the sun derives from the fusion process.

Standard 8: Society (Energy production, environment, economics)

Core Standard

Understand the impact of energy production and use on society and the environment.

- ICP.8.1. Describe how energy needs have changed throughout history and how energy needs are met in modern society.

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- ICP.8.2. Describe the benefits and risks of the development of non-renewable forms of energy such as coal, oil, natural gas and uranium fission sources.
- ICP.8.3 Describe the benefits and risks of the development of renewable forms of energy such as solar energy, wind-energy, geothermal energy, fusion energy and biofuels.
- ICP.8.4 Describe how efficient usage of renewable and non-renewable energy sources are essential to maintaining an environment which supports life.
- ICP.8.5. Describe how the availability of energy resources is essential to the development of an economic society.
- ICP.8.6 Contrast the dependence and use of energy on the economic status of industrial nations, developing nations and undeveloped nations of the third world.
- ICP.8.7 Describe the energy needs of a modern urban city, and compare and contrast these needs with those of a rural community.

Biology I

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Standard 1: Cellular Chemistry

Core Standard

Describe the basic molecular structure and function of the four major categories of biomolecules (carbohydrates, lipids, proteins and nucleic acids) inside cells.

Core Standard

Describe how the majority of the work done in the cell is performed by proteins whose function depends on the amino acid sequence and subsequent shape of the molecule.

- B.1.1 Describe the structure of the major categories of biomolecules in terms of the small number of chemical elements (carbon, hydrogen, nitrogen, oxygen, phosphorous, and sulfur) from which they are composed and the building blocks of which each is made (nucleic acids are polymers of nucleotides, polysaccharides are polymers of sugars, etc).
- B.1.2 Understand and describe the type of work that is carried out in the cell by the many different types of molecules it assembles, such as proteins, lipids, carbohydrates, and nucleic acids.
- B.1.3 Explain that basic cellular metabolism is similar in all cells, and is comprised of chemical reactions catalyzed primarily by protein enzymes whose specific functions depend on their shape.
- B.1.4 Demonstrate that most cells function best within a narrow range of temperature and acidity and that extreme changes may harm cells, modifying the structure of their protein molecules and therefore, some possible functions.

Standard 2: Cellular Structure

Core Standard

Describe features that are common to all cells and contrast those with distinctive features that allow them to carry out specific functions.

- B.2.1 Describe features common to all cells that are essential for growth and survival, and explain their functions.
- B.2.2 Recognize and explain that animals are among the few organisms whose cells lack external cell walls, and relate this to types of cellular movement and to organisms' ability to maintain the concentration of material dissolved in the water surrounding its cells.
- B.2.3 Explain that plant cells contain chloroplasts in addition to the same organelles as animal cells, and that chloroplast activity depends upon exposure to light.

- B.2.4 Explain the functions of eukaryotic cellular organelles with relationship to protein production.
- B.2.5 Explain that different types of cells exist in multicellular organisms and that they produce characteristic sets of proteins that define their functions.
- B.2.6 Describe the theory of how chloroplasts and mitochondria are derived from bacteria, and explain how the DNA sequences of these organelles' genomes strongly support this concept.

Standard 3: Matter Cycles and Energy Transfer

Core Standard

Describe how the sun's energy is captured and used to construct sugar molecules which can serve as building blocks of other biomolecules.

Core Standard

Diagram how matter is conserved and cycles within the global ecosystem, while energy flows through all living organisms and is eventually dissipated as heat.

- B.3.1 Describe how the sun's energy is captured by photosynthetic pigments in chloroplasts and used by plant cells to transform carbon dioxide and water into sugar molecules.
- B.3.2 Compare how producers and consumers use sugar molecules to synthesize a variety of biologically important molecules, including adenosine triphosphate (ATP).
- B.3.3 Recognize and describe that metabolism consists of all of the biochemical reactions that occur inside cells, including the production, modification, transport, and exchange of materials that are required for the maintenance of life.
- B.3.4 Describe the relationship of the organic molecules in a food chain to the energy in a food chain, and explain that consumers retain only a minority of organic molecules, and metabolize a majority of organic molecules for ATP production.
- B.3.5 Explain how the atoms of organic molecules are recycled in the global ecosystem, while energy "flows" irreversibly through food chains.

Standard 4: Interdependence

Core Standard

Describe the living and nonliving components of ecosystems and how the relationship between these components is in flux and can easily be disrupted by human and natural changes.

- B.4.1 Explain that the amount of life an environment can support is limited by the available energy, water, oxygen, and minerals, and by the ability of ecosystems to recycle the residue of dead organic materials.
- B.4.2 Recognize that human activities and technology can change the flow and reduce the fertility of the land.
- B.4.3 Describe the consequences of introducing non-native species into new ecosystems and identify characteristics that may make these species harmless, or that might enable them to compete with native species.
- B.4.4 Describe how changes in the physical or chemical environment can affect the stability of an ecosystem and in turn affect its biodiversity and distribution of organisms.
- B.4.5 Describe how the maintenance of a relatively stable internal environment is required for the continuation of life and explain how stability is challenged by changing physical, chemical, and environmental conditions, as well as the presence of disease agents.

Standard 5: Molecular Basis of Heredity

Core Standard

Describe the basic structure of DNA and its role as the hereditary molecule that directs the production of proteins.

- B.5.1 Describe the basic structure of the DNA molecule and how it relates to genes and chromosomes.
- B.5.2 Understand and explain that the information passed from parents to offspring is transmitted by means of genes which are regions within DNA molecules.
- B.5.3 Demonstrate how the instructions for protein sequences are encoded in DNA molecules.
- B.5.4 Demonstrate that the sequence of the amino acids determines the final folded shape of a protein and therefore its activity.

B.5.5 Describe the significance of the findings made by Rosalind Franklin, Maurice Wilkins, James Watson, and Francis Crick.

Standard 6: Heredity and Reproduction

Core Standard

Describe how biological traits are passed from parents to offspring, producing variations that may not be obvious for generations.

Core Standard

Explain how genetic variation within a population (a species) can be attributed to mutation and subsequent gene recombination.

- B.6.1 Describe and illustrate the inheritance patterns of different types (dominant, recessive, codominant, sex-linked, incomplete dominance, multiple alleles) of genetic traits over many generations.
- B.6.2 Illustrate that the sorting and recombination (crossing over) of genes in sexual reproduction results in a great variety of possible allele combinations from the offspring of any two parents.
- B.6.3 Explain and demonstrate how inserting, substituting or deleting segments of a DNA molecule can alter a gene, which is then passed on to every cell that develops from it.
- B.6.4 Identify factors that can damage DNA and cause changes in its nucleotide sequence (X-rays, radioactivity, environmental chemicals, oxygen radicals), and explain that many of these factors are a part of the natural environment.
- B.6.5 Describe how alterations in genes may be passed on to every cell that develops from it and the resulting traits may be beneficial, detrimental or have little or not effect on the offspring's success in its environment.
- B.6.6 Explain how Barbara McClintock's observations of unusual patterns of genetic inheritance led to the discovery of transposable elements (jumping genes).
- B.6.7 Explain that after the publication of Origin of Species, biological evolution was supported by the rediscovery of the genetics experiments of an Austrian monk, Gregor Mendel, by the identification of genes and how they are sorted in reproduction, and by the discovery that the genetic code found in DNA is the same for almost all organisms.

Standard 7: Gene Expression and Development

Core Standard

Recognize the control of gene expression is necessary for development because all somatic cells of an organism are derived by mitotic division from a single cell (e.g. fertilized egg) and therefore have identical genes.

- B.7.1 Explain how most animals develop from a single cell (e.g. fertilized egg), and how all somatic cells therefore contain identical genetic information.
- B.7.2 Understand that during the development of complex multicellular organisms, cell differentiation is regulated by expression of different genes within different cells.
- B.7.3 Recognize that plant and animal development is directed in large part by proteins that affect cell-cell interactions, and those very small changes in these proteins or in their patterns of expression can change the appearance of the fully-developed individual.

Standard 8: Evolution

Core Standard

Describe how biochemical, fossil, anatomical, developmental, and genetic findings are used to determine relationships of organisms, producing modern classification systems.

Core Standard

Describe how modern evolutionary theory provides an explanation that accounts for history of life on earth and the similarities evident between organisms today.

- B.7.1 Examine anatomical similarities and differences among organisms, and use these observations to explain the hierarchy of relationships. Discuss and develop alternative hypotheses that could explain how this pattern of relationships might have been produced.
- B.7.2 Examine DNA or protein sequences for similarities and differences, and evaluate the genetic relationships or organisms indicated by their genetic information. Compare the genetic relationships identified by this method to the anatomical similarities used in grouping and naming organisms.
- B.7.3 Describe how natural selection leads to organisms that are well-suited for survival and reproduction in particular environments, and illustrate with examples.
- B.7.4 Trace the relationship between environmental changes and changes in the gene pool. Recognize genetic drift as a process that can change gene pools in small populations

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without natural selection, and recognize the isolation of sub-populations as a mechanism by which one founder species can give rise to two or more descendent species.

- B.7.5 Describe Darwin's theory of evolution by natural selection and recognize that its success, came from the clear argument it made, including the comparison of natural selection to the selective breeding of animals in wide use at the time, and from the biological and fossil evidence from which he built the argument.
- B.7.6 Describe the observations that suggest that life on earth began as simple, one-celled organisms about 4 billion years ago, that cells with nuclei developed about a billion years ago, and increasingly complex multicellular organisms evolved later.

Chemistry I

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Standard 1: Properties and States of Matter

Core Standard

Describe the nature of physical and chemical properties and changes of matter.

Core Standard

Compare and contrast states of matter at the molecular level.

- C.1.1 Differentiate between pure substances and mixtures based on physical properties.
- C.1.2 Observe and describe physical properties of different types of matter and designate them as either extensive or intensive.
- C.1.3 Recognize observable indicators of chemical changes.
- C.1.4 Describe physical and chemical changes at the molecular level.
- C.1.5 Describe the characteristics of solids, liquids, and gases and state changes at the molecular level.
- C.1.6 Explain and apply the law of conservation of mass as it applies to chemical changes.
- C.1.7 Define density and distinguish between materials based on densities. Perform calculations involving density.

Standard 2: Atomic Structure and the Periodic Table

Core Standard

Describe how the numbers and arrangement of electrons and protons relates to the structure of the periodic table and the properties of each element.

Core Standard

Describe how the properties and arrangement of the subatomic particles contributes to the structure of the atom.

- C.2.1 Describe the historical development of the modern atomic theory.
- C.2.2 Describe how the subatomic particles contribute to the structure of an atom.
- C.2.3 Determine the number of protons, neutrons, and electrons in atoms and their isotopes. Relate these numbers to atomic number and mass number.
- C.2.4 Calculate the average atomic mass of an element from its isotopes.

- C.2.5 Write the electron configuration of an element and relate this to its position on the periodic table.
- C.2.6 Use the periodic table and electron configurations to determine an element's number of valence electrons, ionic charge, and properties.
- C.2.7 Use the periodic table to compare attractions that atoms have for electrons and explain the periodic properties based on these attractions.
- C.2.8 Describe types of nuclear reactions. Write and balance nuclear equations.
- C.2.9 Make calculations based on half-lives and the amount of radioactive material.

Standard 3: Bonding and Molecular Structure

Core Standard

Describe the relationship between the arrangement of electrons in ionic and covalent bonding.

Core Standard

Describe the attractive forces between molecules and how they affect properties.

- C.3.1 Describe the characteristics of ionic and covalent compounds.
- C.3.2 Compare and contrast how ionic and covalent compounds form.
- C.3.3 Compare and contrast intermolecular forces and how they differ from ionic and covalent bonds.
- C.3.4 Based on the strength of molecular and atomic attractions, explain the physical properties of substances.
- C.3.5 Draw structural formulas for and name simple molecules.
- C.3.6 Predict chemical formulas for and name ionic compounds.

Standard 4: Reactions and Stoichiometry

Core Standard

Use balanced chemical equations and the mole concept to determine the quantities of reactants and products

C.4.1 Predict products of simple reactions.

C.4.2 Balance chemical equations using the law of conservation of mass and use them to describe chemical reactions.

C.4.3 Use the mole concept to determine moles, mass, and number of particles for elements and compounds.

C.4.4 Using a balanced chemical equation, calculate the amounts of reactants needed or products made in a chemical reaction.

C.4.5 Recognize and classify types of reactions.

C.4.6 Determine oxidation states and identify the substances gaining and losing electrons in reactions.

C.4.7 Perform calculations based on percent composition, empirical and molecular formulas.

Standard 5: Behavior of Gases

Core Standard

Using the kinetic molecular theory, describe and explain the behavior of ideal gases.

Core Standard

Examine the relationship between moles, volume, pressure, and temperature as it relates to gases.

C.5.1 Use kinetic molecular theory to explain changes in gas volumes, pressure, moles, and temperature.

C.5.2 With gases or mixtures of gases, perform calculations that demonstrate an understanding of the gas laws, including the ideal gas law.

C.5.3 Given a chemical equation involving a gas, perform calculations of the amounts of reactants needed or products made in a chemical reaction.

Standard 6: Thermochemistry

Core Standard

Recognize that chemical reactions result in either the release or absorption of energy.

Core Standard

Apply the law of conservation of energy.

C.6.1 Distinguish between the concepts of temperature and heat flow as it relates to the motion of molecules.

C.6.2 Solve problems involving heat flow and temperature changes, using known values of specific heat and/or phase change constants.

C.6.3 Classify chemical reactions and phase changes as exothermic or endothermic.

Standard 7: Solutions

Core Standard

Describe the composition and characteristics of solutions.

Core Standard

Identify the factors that qualitatively affect solubility, reaction rates and dynamic equilibrium.

C.7.1 Describe the composition and properties of types of solutions.

C.7.2 Explain how changes in temperature, surface area, and pressure affect solubility.

C.7.3 Describe the concentration of solutions in terms of molarity. Perform calculations using molarity, mass, and volume.

C.7.4 Use chemical equations and solution concentrations to perform calculations.

C.7.5 Prepare a solution of a given molarity.

C.7.6 Explain how the rate of a reaction is qualitatively affected by changes in concentration, temperature, surface area, and the use of a catalyst.

C.7.7 Describe dynamic equilibrium in terms of changes in amounts of reactants and products.

C.7.8 Write equilibrium expressions for reversible reactions.

Standard 8: Acids and Bases

Core Standard

Use acid-base models to recognize acids and bases by formulas and reactions.

Core Standard

Distinguish between the relative strengths of acids and bases and explain the meaning of the value indicated by the pH scale.

C.8.1 Use Arrhenius and Bronsted-Lowry models to classify substances as acids or bases.

C.8.2 Describe the properties of acids and bases.

C.8.3 Compare and contrast the dissociation and strength of acids and bases in solution.

C.8.4 Given the hydrogen (H_3O^+) ion concentration in a solution, calculate the pH, and vice versa. Explain the meaning of these values.

C.8.5 For an acid-base titration, calculate the concentration of an unknown solution.

Earth and Space Science I

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Standard 1: The Universe

Core Standard

Describe the age, origin and evolution of the universe

Core Standard

Describe the size and organization of stars and galaxies found within the universe.

- ES.1.1 Describe the Big Bang theory and understand that evidence to support the formation of the universe and its age is found in Hubble's law.
- ES.1.2 Differentiate between the different types of stars, including our sun, found on the Hertzsprung - Russell diagram. Compare and contrast the evolution of stars of different masses.
- ES.1.3 Understand and discuss the basics of the fusion processes that are the source of energy of stars and the formation of the elements.
- ES.1.4 Understand and explain the hierarchical relationship and scales of planetary systems, stars, multiple-star systems, star clusters, galaxies, and galactic groups in the universe.

Standard 2: The Solar System

Core Standard

Describe the age, origin and evolution of our solar system and describe the characteristics of objects in our solar system.

Core Standard

Recognize the role of gravity and other forces in determining the motion of bodies in the solar system.

- ES.2.1 Understand and discuss the nebular theory concerning the formation of solar systems. Include in the discussion the roles of planetesimals and protoplanets.
- ES.2.2 Describe the motions of the various kinds of objects in our solar system, including planets, satellites, comets, and asteroids. Explain that Kepler's laws determine the orbits of those objects.
- ES.2.3 Describe the characteristics of the various kinds of objects in our solar system, including planets, satellites, comets, and asteroids. Recognize that planets have been identified in other solar systems.

- ES.2.4 Recognize that the sun is the main source of external energy for the earth. Describe the cycles of solar energy and their impact on earth.

Standard 3: The Earth

Core Standard

Recognize and describe that earth sciences address planet-wide interacting systems, including the oceans, the air, the solid earth, and life on earth, as well as interactions with the solar system.

Core Standard

Examine the interrelationships between society and the planet-wide interacting systems and understand the basic physical and chemical laws that control these interactions.

- ES.3.1 Recognize and describe how the earth sciences address planet-wide interacting systems, including the hydrosphere, atmosphere, lithosphere, and biosphere
- ES.3.2 Demonstrate the possible effects of atmospheric changes brought about by natural and manmade processes.
- ES.3.3 Differentiate between renewable and nonrenewable resources in each of earth's systems. Compare the pros and cons of using these resources.
- ES.3.4 Recognize that fundamental physical and chemical laws have controlled the past, present, and future dynamic interactions between and within earth systems.

Standard 4: The Atmosphere and Hydrosphere

Core Standard

Understand the structure and circulation of Earth's atmosphere and hydrosphere and explain how natural and human factors interact with these processes.

Core Standard

Understand that both weather and climate involve the transfer of matter and energy throughout the atmosphere and hydrosphere as driven by solar energy and gravity

- ES.4.1 Examine the origins, structure, composition, and function of Earth's atmosphere. Include the role of living organisms in the production and cycling of atmospheric gases.

- ES.4.2 Explain the importance of heat transfer between and within the atmosphere, land masses, and bodies of water.
- ES.4.3 Explain the role of Milankovitch cycles (rotation, revolution, and procession of axis) on differential heating of Earth, leading to climate changes such as the cycles of glaciation.
- ES.4.4 Understand and describe the origin, life cycle, behavior, and prediction of weather systems. Investigate the causes of severe weather and propose appropriate safety measures that can be taken in the event of severe weather.
- ES.4.5 Understand the origin, movement, effects and uses of tides.
- ES.4.6 Describe the relationship among ground water, surface water, and glacial systems in the water cycle. Discuss the effect of human interactions with the water cycle.

Standard 5: The Solid Earth

Core Standard

Understand the structural and compositional layers of the earth, its magnetic field, and how this knowledge is based on data from direct and indirect observation.

Core Standard

Understand how the processes of rock formation, weathering, sedimentation, and reformation continually shape the surface of the Earth.

- ES 5.1 Explain how sea level changes over time have exposed continental shelves, created and destroyed inland seas, and shaped the surface of the land.
- ES 5.2 Understand the role of changing sea level and climate in the formation of the sedimentary rocks of Indiana.
- ES.5.3 Compare and contrast the properties of rocks and minerals. Explain the uses of rocks and minerals in daily life, particularly those found in Indiana.
- ES 5.4 Describe the large scale structure and compositional layers of the Earth.
- ES.5.5 Understand the origin and implications of Earth's magnetic field.

- ES.5.6 Illustrate the various processes that are involved in the rock cycle and discuss the conservation of matter during formation, weathering, sedimentation, and reformation.
- ES.5.7 Understand the concepts of relative and absolute geologic time through evidence from fossils and radioactive dating.

Standard 6: Earth Processes

Core Standard

Understand the cyclical nature of processes that modify the Earth and how humans interact with these cycles.

Core Standard

Understand the role of plate tectonics in controlling the large scale structure of Earth's surface. Understand how the dynamic Earth impacts human society.

- ES.6.1 Understand and discuss the development of plate tectonic theory based on evidence that supports the movement of the plates by sea floor spreading, such as magnetic reversals, fossil evidence, and the continuity of geological features on separate continents.
- ES.6.2 Explain the origin of geologic features and processes that result from plate tectonics such as earthquakes, volcanoes, trenches and mountain ranges.
- ES.6.3 Investigate and discuss how humans affect and are affected by geological systems and processes.
- ES.6.4 Differentiate among the processes of weathering, erosion, transportation of materials, deposition, and soil formation.

Environmental Science, Advanced

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- Use analogies and models (mathematical and physical) to simplify and represent systems that are difficult to understand or directly experience due to their size, time scale, or complexity, and recognize the limitations of analogies and models.
- Focus on the development of explanatory models based on their observations during laboratory investigations.
- Explain that the body of scientific knowledge is organized into major theories, which are derived from and supported by the results of many experiments, and allow us to make testable predictions.
- Recognize that new scientific discoveries often lead to a re-evaluation of previously accepted scientific knowledge and of commonly held ideas.
- Describe how scientific discoveries lead to the development of new technologies, and conversely how technological advances can lead to scientific discoveries through new experimental methods and equipment.
- Explain how scientific knowledge can be used to guide decisions on environmental and social issues.

Standard 1: Environmental Investigation

Core Standard

Understand that scientific knowledge, new technologies, and economic growth is often gained through experimentation and investigation.

- ES.1.1 Assess the biotic and abiotic factors of a local environment. Determine how these factors work together to create this environment.
- ES.1.2 Use the appropriate technology to make observations, collect, organize, and interpret data, draw conclusions, and develop explanations.
- ES.1.3 Evaluate accuracy and reliability of data and information.
- ES.1.4 Communicate results to appropriate audiences, within the school and local community. Extrapolate how this new information may be used to improve the environment or the local community.

Standard 2: Structure and Function of an Environment

Core Standard

Describe features that all environments have in common and recognize that each environment has its own unique components (both biotic and abiotic) that interact to determine how the environment functions.

- ES.2.1 Distinguish between natural and human-modified environments. Compare and contrast the purpose and functioning of these environments.
- ES.2.2 Note the ways that matter cycles, is transformed, and is stored in the environment.
- ES.2.3 Follow the path that energy travels as it is transformed and flows through the environment. Recognize that energy is constantly being added to, and leaving the environment.
- ES.2.4 Recognize that the biodiversity of an environment is dependent on the needs of the individual organisms, the biotic factors, and the abiotic factors of the environment.
- ES.2.5 Evaluate how human actions have impacted the biotic and/or abiotic components of the environment.
- ES.2.6 Recognize that there are both natural and human initiated changes in the environment. These changes may be cyclical or permanent.

- ES.2.7 Identify types of environmental pollutions, differentiating between point and non-point sources.

Standard 3: Understanding and Addressing Current Environmental Issues

Core Standard

It is important to be familiar with environmental issues that range from local to national to global in scale. These issues are often linked with each other and linked with economic, social, and political factors.

- ES.3.1 Be aware of the significant ways that invasive species may alter an environment.
- ES.3.2 Note the availability of quality drinking water on local, national, and global levels.
- ES.3.3 Look at the Earth's climate history and note climate changes. Suggest causes for these changes and ways to combat them. Speculate on the possible future local or global effects of climate change.
- ES.3.4 Suggest ways that waste management and product life cycle influence local environments.
- ES.3.5 Know the advantages and the struggles of greening urban environments.
- ES.3.6 Determine how land use and habitat degradation affect biodiversity.
- ES.3.7 Identify surface water quality issues in your community.
- ES.3.8 Determine factors that influence air quality. Differentiate between human and natural factors.
- ES.3.9 Determine what the main source of energy used locally/nationally is. Illustrate how the management of energy use affects the community and environment.
Energy use/production/management

Standard 4: Sustainability

Core Standard

Integrate the concept of sustainability (ensuring an indefinite supply of resources for future generations) with the concepts of resource management, demographics, limited natural resources, pollution, and nutrient cycles, and with the concept of stewardship.

- ES.4.1 Demonstrate that human populations influence the use of natural resources, food production, and the generation of waste.

- ES.4.2 Differentiate between renewable and nonrenewable resources as they affect sustainability.
- ES. 4.3 Assess the importance of resource management for a variety of resources.
- ES.4.4 Assess the use of energy resources and determine the life expectancy of that fuel source.
- ES.4.5 Explore possible local alternative energy sources.
- ES.4.6 Identify local, national, and global limited resources.
- ES.4.7 Identify “tradeoffs” between the natural resource use, the economy, and environmental quality.
- ES.4.8 Recognize that uneven distribution of natural resources affects resource management decisions. These decisions may impact the environment, economic, and political relations at regional, national, and global levels.

Standard 5: Historical Perspectives on the Environment

Core Standard

Understand that individual and societal values of any given time period will influence the environmental decisions of that time, sometimes with unintended consequences. Develop an appreciation for the complexity of the decision-making process involved in preserving our natural environment.

- ES.5.1 Differentiate between the principles of conservation and preservation. Discuss which policy best meets current environmental needs.
- ES.5.2 Investigate past and current policies in dealing with the issue of pollution.
- ES.5.3 Investigate how biomagnification of toxins as a result of pesticide (DDT) use has changed the current use of pesticides.
- ES.5.4 Investigate possible solutions for the issue of fertilizer use, increased crop production and the effects on the fishing industry.

Physics I

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Standard I: Motion and Forces

Core Standard

Describe and explain the motion of macroscopic objects in terms of Newton's Laws.

- P.1.1 Describe, measure, and analyze constant velocity motion in terms of time and the vector quantities of displacement and velocity.
- P.1.2 Describe, measure, and analyze constant acceleration motion in terms of time and the vector quantities of displacement, velocity, and acceleration.
- P.1.3 Use Newton's laws of motion to predict and explain the motion of objects both quantitatively and qualitatively in one and two dimensions.
- P.1.4 Describe, measure, and analyze projectile motion.
- P.1.5 Describe, measure, and analyze uniform circular motion including orbital motion.
- P.1.6 Explain and use Newton's law of universal gravitation, and explain how it determines the acceleration due to gravity on Earth.

Standard 2: Energy and Momentum

Core Standard

Describe and explain motion in terms of energy, momentum and their conservation laws.

- P.2.1 Describe qualitatively and quantitatively the concepts of momentum, energy, work, and power.
- P.2.2 Analyze evidence that illustrates the laws of conservation of energy and conservation of momentum. Apply these laws to understanding motion.
- P.2.3 Define and quantify the concepts of momentum and energy and distinguish between them.
- P.2.4 Describe and quantify energy in its different mechanical forms (such as kinetic, gravitational potential, elastic potential) and recognize that these forms of energy can be transformed one into another and into non-mechanical forms of energy (such as thermal, chemical, nuclear, and electromagnetic).

- P.2.5 Describe and calculate work, energy, and power, and explain and apply the relationships among them.
- P.2.6 Explain circumstances under which the laws of conservation of energy and momentum may be used and apply these laws to predict, both qualitatively and quantitatively, the results of the interactions between objects.

Standard 3: Temperature and Thermal Energy Transfer

Core Standard

Understand the kinetic-molecular theory of matter and apply it to temperature and energy transformations.

- P.3.1 Describe temperature, thermal energy, and thermal energy transfer in terms of the kinetic molecular model. Apply the concepts of conservation of energy to include thermal energy.
- P.3.2 Describe the kinetic molecular model and how it explains the relationship between the temperature of an object and the average kinetic energy of its molecules.
- P.3.3 Explain thermal energy transfer by conduction, convection, and radiation.
- P.3.4 Use the concept of conservation of energy and the mechanical equivalent of heat to predict and explain thermal energy transfers.

Standard 4: Electricity and Magnetism

Core Standard

Understand the interplay of electricity and magnetism. Apply this understanding to electrostatic problems and basic electrical circuits.

- P.4.1 Describe and determine the forces on a stationary charge due to other charges (Coulomb's Law) or electric fields.
- P.4.2 Describe electric potential (voltage) and its role in explaining the movement of electrical charges and currents.
- P.4.3 Explain and analyze simple arrangements of electrical components in series and parallel circuits in terms of current, resistance, voltage, and power.
- P.4.4 Describe the magnetic forces and fields produced by and acting on moving charges and magnetic materials.

- P.4.5 Explain the production of electric current by changing magnetic fields and the production of magnetic fields by electric currents.

Standard 5: Vibrations, Waves and Sound

Core Standard

Understand motion in terms of displacement, velocity, and acceleration.

- P.5.1 Identify properties of objects that vibrate, using Newton's laws to understand the motion. Understand that vibrating objects create mechanical waves.
- P.5.2 Understand the relationships between frequency, period, amplitude, wavelength and wave speed.
- P.5.3 Describe and analyze vibrations and waves in terms of their fundamental characteristics (such as wave speed, wavelength, frequency or period, and amplitude).
- P.5.4 Explain the behavior of waves (such as transmission, reflection, and interference).
- P.5.5 Apply the principles of waves to sound. Distinguish longitudinal from transverse waves and analyze sound as an example of a longitudinal wave.

Standard 6: Light and Optics

Core Standard

Understand the geometric nature of light propagation and its wave properties in terms of the propagation of light through space, and its interactions with and in matter.

- P.6.1 Understand the geometric nature of light in reflection and refraction, and in image formation by lenses and mirrors.
- P.6.2 Describe the whole electromagnetic spectrum (radio waves, microwaves, infrared, visible light, ultraviolet, X-rays, gamma rays) in terms of frequency, wavelength and energy, recognizing that all these waves travel at the same speed in a vacuum.
- P.6.3 Understand the many applications we make of this the parts of the electromagnetic spectrum in our everyday lives.
- P.6.4 Explain the motion of light through space and matter using the wave concepts of reflection, refraction, polarization, transmission, and absorption.

Standard 7: Modern Physics

Core Standard

Understand how our knowledge of physics has changed during the last hundred years, particularly in the areas of atomic and nuclear physics, quantum theory, and relativity.

- P.7.1 Demonstrate how historical models and experiments supported our development of and current understanding of each atom as a nucleus of protons and neutrons, surrounded by a number of electrons.
- P.7.2 Describe how the development of quantum theory and relativity changed our understanding of nature.
- P.7.3 Describe how the binding energies of protons and neutrons determine the stability/instability of nuclei; and how these vary throughout the periodic table. Describe the process of fission in heavy nuclei such as the uranium isotopes.
- P.7.4 Relate the fission process to the human development and use of the fission process in war (uncontrolled) and in peace (controlled).
- P.7.5 Describe the collision process of fusion in light nuclei, and understand how this process produces the energy of the sun and stars.
- P.7.6 Understand the human development and use of the fusion process in war (uncontrolled) and in peace (controlled).
- P.7.7 Describe the role of the strong and weak nuclear forces in determining the size of the nucleus, in binding protons and neutrons together, and explain their roles in the processes of radioactive decay (alpha, beta, and gamma decays).

Standard 8: Society (Energy production, environment, economics)

Core Standard

Discuss how the rapid increase in our understanding and knowledge of physics in the last hundred years has enhanced and changed our lives.

- P.8.1. Describe how energy needs have changed throughout history and how energy needs are met in modern society.
- P.8.2. Describe the development of non-renewable forms of energy such as coal, oil, natural gas and uranium fission sources.

- P.8.3 Describe the development of renewable forms of energy such as solar energy, wind-energy, geothermal, fusion energy and biofuels.
- P.8.4 Describe how efficient usage of renewable and non-renewable energy sources are essential to maintaining an environment which supports life.
- P.8.5. Describe how the availability of energy resources is essential to the development of an economic society.
- P.8.6 Contrast the dependence and use of energy on the economic status of industrial nations, developing nations and undeveloped nations of the third world.

Anatomy and Physiology

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STANDARD 1: Levels of Organization in the Human Body

Cellular

Analyze and explain the structure of matter, the chemical constituents of the cell, and how materials cross the plasma membrane. Investigate and describe cellular metabolism, which contributes to homeostasis, and predict the consequences of the failure to maintain homeostasis. Discuss somatic cell division and investigate cellular differentiation within the human body. Introduce the idea that multiple cells will contribute to the formation of tissues within body organs.

Standard Indicators:

- AP 1.1 Compare and contrast diffusion and osmosis, facilitated diffusion, active transport, endocytosis, and exocytosis.
- AP 1.2 Describe the importance of proteins in cell function and structure. Give specific examples of proteins and their functions and describe how proteins are synthesized.
- AP 1.3 Review the stages of mitosis and discuss differences in the lifespan among various types of cells.

STANDARD 2: Levels of Organization in the Human Body

Tissue

Examine the role of adhesion molecules and how these contribute to tissue formation. Analyze the relationships between anatomical structures and the physiological functions of tissues including connective, epithelial, muscle and nervous tissues as well as various types of membranes. Compare and contrast the specific cells and proteins that make up each of these tissue types.

Standard Indicators:

- AP 2.1 Compare and contrast the structure, function, and location of cells that make up the various types of muscle tissue, nerve tissue, and connective tissue.
- AP 2.2 Describe the general structure of an epithelium, including the basement membrane. Describe the types and locations of epithelia. Describe endocrine and exocrine glands and their development from glandular epithelium. Compare and contrast epithelial and synovial membranes.

STANDARD 3 : Movement and Support in the Human Body

The Skin and the Integumentary System

Analyze the structures of the skin, including skin layers as well as accessory structures such as hair follicles, glands and nails. Relate the function of the skin to the maintenance of homeostasis (i.e., regulate body temperature, slow water loss, house sensory receptors, synthesize various biochemicals and excrete waste). Evaluate the cause and effect of diseases associated with the integumentary system (i.e., the inflammatory and the healing processes).

Standard Indicators:

- AP 1.5 Discuss the important physiological functions of the skin. Describe the structure of the skin, including the hypodermis, dermis, and the layers of the epidermis. Discuss the accessory structures of the skin: hairs, nails, and glands.

STANDARD 4: Movement and Support in the Human Body

The Skeletal System

Introduce students to general anatomical terminology. Outline the structure, the development and growth and the functions of bones. Distinguish bones according to shape, function and location in the skeleton. Describe the major types of joints in terms of their mobility and the tissues that hold them together. Analyze and describe the effects of pressure, movement, torque, tension and elasticity on the human body. Examine the microscopic organization of cortical bone and identify cells involved in maintenance of bone mass density. Include a brief discussion of osteoporosis and complications of this bone disease.

Standard Indicators:

- AP 4.1 Explain the anatomical position and the terms that describe relative positions, body planes, and body regions. Describe the body cavities, their membranes, and the organs within each cavity; the major organ systems; and their role in the functioning of the body.
- AP 4.2 Describe the structure of a typical long bone and indicate how each part functions in the physiology and growth of the bone
- AP 4.3 Distinguish the axial from the appendicular skeleton, and name the major bones of each. Locate and identify the bones and the major features of the bones that make up the skull, vertebral column, thoracic cage, pectoral girdle, upper limb, pelvic girdle, and lower limb.
- AP 4.3 Compare and contrast the microscopic organization of compact (cortical) bone and spongy (trabecular) bone.

STANDARD 5: Movement and Support in the Human Body

The Muscular System

Compare and contrast the microscopic structure, organization, function and molecular basis of contraction in skeletal, smooth and cardiac muscle. Illustrate conduction systems such as nerve transmission in muscle stimulation. Identify major muscles in the body and discuss associated movements. Research and describe therapeutic uses and effects of external sources of electricity on the body system.

Standard Indicators:

- AP 5.1 Name the components of a skeletal muscle fiber and describe their functions. Describe how the thin and thick filaments are organized in the sarcomere. Explain the molecular processes and biochemical mechanisms that provide energy for muscle contraction and relaxation.

- AP 5.2 Describe a motor unit and its importance in controlling the force and velocity of muscle contraction. Describe the neuromuscular junction and the neurotransmitter released at the neuromuscular junction.
- AP 5.3 Distinguish between isotonic and isometric contractions of skeletal muscle; cite examples of each and discuss how muscle contraction is amplified by the use of lever systems.
- AP 5.4 Identify the major muscles on a diagram of the body's musculature and/or through dissection and describe the movements associated with each muscle.
- AP 5.5 Explain what is meant by muscular hypertrophy and atrophy and discuss causes of these conditions.

STANDARD 6: Integration and Coordination in the Human Body

The Nervous System

Recognize that the nervous system is divided into the peripheral nervous system and the central nervous system and understand the structure and function of both systems. Evaluate the application of advanced technologies such as electroencephalogram (EEG), electrocardiogram (ECG), bionics, transcutaneous electrical nerve stimulation (TENS) and cardioversion.

Standard Indicators:

- AP 6.1 Distinguish the structures of the various functional types of neurons; diagram the structure of a motor neuron and explain the function of each component
- AP 6.2 Describe the different types of neuroglial cells. Describe the function of oligodendrocytes and Schwann cells; describe the structure and function of the myelin sheath and the role that Schwann cells play in regeneration of a severed nerve axon.
- AP 6.3 Discuss mathematically the origin of the resting potential, referring to the intra- and extracellular concentrations of sodium and potassium ions, the permeability of the plasma membrane to these ions, and the intracellular concentration of negatively-charged proteins.
- AP 6.4 Explain the changes in membrane potential during the action potential and their relationship to the number of open channels for sodium and potassium ions.
- AP 6.5 Explain the role of excitatory and inhibitory neurotransmitters in a synapse. Explain why is it important to remove a neurotransmitter after it has been released and describe two mechanisms for doing this.
- AP 6.6 Describe the meninges that cover the brain and spinal cord. Describe the ventricles in the brain and how they are interconnected. Describe the secretion, flow pathways, and absorption of cerebrospinal fluid, its locations, and explain its functions.
- AP 6.7 Discuss the functions of the spinal cord. Describe the five segments (regions) of the spinal cord and explain its organization in terms of gray matter; white matter; dorsal and ventral roots.
- AP 6.8 Discuss the components and broad function of the brain stem and the diencephalon. Describe and give the functions of the various structures that make up the cerebrum including the cerebral cortex and its anatomical divisions, the cerebral components of the basal ganglia, and the corpus callosum.

- AP 6.9 Describe the structure and functions of the cerebellum and its nuclei regarding postural control, smooth coordination of movements, and motor learning
- AP 6.10 Describe the major characteristics of the autonomic nervous system and contrast its efferent pathways with those of somatic nervous system. Compare and contrast the actions, origins and pathways of nerve fibers in the parasympathetic and sympathetic divisions of the autonomic nervous system including their associated ganglia and neurotransmitters.

STANDARD 7: Integration and Coordination in the Human Body

Somatic and Special Senses

Distinguish between somatic senses and special senses and classify sensory receptors according to the types of stimuli that activate them.

Standard Indicators:

- AP 7.1 Explain how information on stimulus intensity and stimulus quality is signaled to the brain.
- AP 7.2 Explain what is meant by sensory receptor adaptation and give examples related to everyday experience.
- AP 7.3 Describe the structure, function, and location of olfactory and taste receptor cells.
- AP 7.4 Identify and describe the parts of the eye. Describe the cells found in the neural retina and the functional dependence of the rods and cones on the pigmented epithelium (the non-neural retina). Compare the structure of rods and cones, describe the fovea and its function, and discuss the relationship of rods and cones to visual acuity, night vision, dark-adaptation, color vision, and color blindness.
- AP 7.5 Describe the three regions of the ear. Distinguish the structure and function of the vestibular apparatus from the auditory apparatus. Describe how sound is transmitted from the external auditory meatus to the cochlea.
- AP 7.6 Explain how the hair cells in the vestibular apparatus and cochlea respond to head tilt, linear acceleration, rotation, and sound.

STANDARD 8: Integration and Coordination in the Human Body

The Endocrine System

Understand the structure and function of the endocrine system in relation to homeostasis, including a discussion of the specific role of hormones and distinguishing between endocrine glands and endocrine tissues that are found in other organs. Provide examples that describe negative feedback in the control of hormone secretion. Analyze the effects of energy deficiencies in malabsorption disorders such as diabetes, hypothyroidism and Crohn's disease.

Standard Indicators:

- AP 8.1 Discuss the difference between an endocrine gland and an exocrine gland. Explain the nature of a hormone and the importance of the endocrine system in relation to digestion and metabolism, homeostasis, survival, growth, development, and reproduction. Contrast the endocrine glands that are purely endocrine with endocrine tissue found in organs that also have other functions.

- AP 8.2 Identify the various chemical classes to which hormones belong and explain that some hormones act via second messengers while others affect gene expression.
- AP 8.3 Discuss neural, hormonal, and other chemical compounds that control hormone secretion.
- AP 8.4 Describe the structure and hormones of the hypothalamus-pituitary complex, and the function of these hormones in controlling the thyroid, gonads, and adrenal cortex. Describe structure of these glands and the functions of the hormones secreted by them. For the glands that are not under the control of the hypothalamus (-pituitary complex - the parathyroid, the pancreas, the pineal gland, and the adrenal medulla), describe their structure, the hormones secreted and their function, and their stimuli for secretion.
- AP 8.5 Discuss how the hypothalamus-pituitary complex, the sympathetic nervous system, the adrenal medulla, and the adrenal cortex are all involved in the response of the body to stress.
- AP 8.6 Explain how the cells of the adrenal medulla supplement the actions of the autonomic nervous system.

STANDARD 9: Transport in the Human Body

The Blood

Analyze the functions of blood including its role to combat invading microorganisms, defense mechanisms (e.g., acute inflammation) and immune responses. Describe the structure and function of formed elements found in the blood and include a general discussion of where and how these formed elements are produced. Define hemostasis and how it is achieved.

Standard Indicators:

- AP 9.1 Distinguish whole blood from plasma and serum. Classify and explain the functions of the formed elements found in blood, and describe where they are produced.
- AP 9.2 Describe how erythropoietin regulates red blood cell production in response to anoxia.
- AP 9.3 Explain the ABO blood types and discuss their importance during a blood transfusion.
- AP 7.4 Describe the basic processes in blood clotting.

STANDARD 10: Transport in the Human Body

The Cardiovascular System

Identify and locate the organs of the cardiovascular system and discuss their functions. Analyze the cardiac cycle and explain how it is controlled. Explain how oxygen and carbon dioxide are transported via the pulmonary and systemic circuits. Interpret normal and abnormal contractility conditions such as edema, glaucoma, aneurysms, hemorrhage and hypertension.

Standard Indicators:

- AP 10.1 Describe the layers found in the walls of blood vessels and discuss the relative prominence of these layers in the different types of blood vessels. Include an

- analysis of vasoconstriction and vasodilatation and their importance in controlling blood flow through tissues. Describe both the venous pump and varicose veins.
- AP 10.2 Diagram the structure of a capillary bed and explain how materials move in and out of capillaries. Discuss edema.
- AP 10.3 Describe the heart: include the pericardium, the layers in its wall, the four chambers, the valves, and the great vessels entering and leaving the heart. Describe the major arteries branching off from the aorta, and the regions they supply; describe the major veins draining into the superior and inferior vena cavae. Explain with diagrams how the heart valves ensure one-way blood flow during systole and diastole. Discuss the heart sounds and the point in the cardiac cycle when they are heard.
- AP 10.4 Discuss the importance of the baroreceptor reflex in the regulation of blood pressure. Explain what is meant by hypertension and mention some of the dangers associated with hypertension.
- AP 10.5 Describe how the action potential of a cardiac muscle cell differs from that of a neuron. Describe the importance of calcium ion influx during the plateau phase of the action potential. Discuss the functioning of pacemaker cells and the how the wave of depolarization is transmitted to the ventricles.
- AP 10.6 Explain the similarities and differences between the adjustment of the cardiovascular system to exercise and hemorrhage. Contrast changes in the distribution of blood flow and cardiac output, and explain the importance of the sympathetic branch of the autonomic nervous system in these responses.

STANDARD 11: Transport in the Human Body

The Lymphatic System and Immune Mechanisms

Identify and locate major organs of the lymphatic system and discuss their functions. Understand that many of the cells of the immune system are formed, reside in and are processed through the structures of the lymphatic system. Illustrate lines of defense including the cellular and non-cellular components of the immune system.

Standard Indicators:

- AP 11.1 Discuss the major anatomical structures and functions of the lymphatic system including the lymphatic vessels; the structure and major groupings of lymph nodes; and the structures and functions of the spleen, thymus, and bone marrow.
- AP 11.2 Discuss the different types of pathogens and outline the strategies the body uses to protect itself from them. Distinguish non-specific, innate or natural immunity from specific or acquired immunity. Recognize their overlap and describe their cellular and non-cellular components.
- AP 11.3 Describe the mechanisms of the acute inflammatory response, its causes, and the role of chemical signaling molecules.
- AP 11.4 Describe the development and maturation of B- and T-lymphocytes. Discuss why the development of self-tolerance is important.
- AP 11.5 Define and discuss antigens, antibodies, and complement.

STANDARD 12: Absorption and Excretion in the Human Body

The Digestive System

Identify and locate major and accessory organs of the digestive system and discuss their functions. Analyze the digestive processes from ingestion to defecation (i.e., how long it takes to digest food, the length of the small intestine, diseases associated with the digestive tract, enzymes secreted and the substrates they act on).

Standard Indicators:

- AP 12.1 Describe the functions of all the structural components and enzymes of the gastrointestinal tract and accessory organs in relation to the processing, digesting, and absorbing of the three major food classes. State the chemical forms in which the three major food classes are absorbed. Explain the roles of the lacteals and the hepatic portal vein in transporting the products of digestion.
- AP 12.2 Describe the regulation of the enzyme and bicarbonate content of the pancreatic juice.
- AP 14.7 Explain the difference between metabolic and respiratory acidosis and alkalosis.
- AP 12.3 Describe the microscopic anatomy of the liver and its relationship to the functions of the liver.

STANDARD 13: Absorption and Excretion in the Human Body

The Respiratory System

Identify and locate major organs of the respiratory system and discuss their functions. Analyze the breathing processes (i.e., inspiration, expiration, respiratory volumes and capacities). Describe how the partial pressures of oxygen and carbon dioxide and pH control ventilation.

Standard Indicators:

- AP 13.1 Contrast inspiration and expiration (quiet and forced) and explain the role of various muscles and of lung elasticity in this process. Compare the percentages of the oxygen and carbon dioxide in the external air to the percentages in the alveolar and the pulmonary capillaries. Explain the meaning of partial pressure.
- AP 13.2 Explain the use of the spirometer and describe the data it generates in a spirogram.
- AP 13.3 Describe the neuronal networks controlling respiration. Contrast and compare the chemoreceptors involved in control of respiration and the stimuli to which they respond. Explain how these receptors affect ventilation under conditions of low arterial oxygen partial pressure, high arterial carbon dioxide, and low arterial pH.

STANDARD 14: Absorption and Excretion in the Human Body

The Urinary System

Identify and locate major organs of the urinary system and discuss their functions. Understand the importance of blood flow through the kidneys and the role of the nephron in the filtration process. Outline the flow of blood through the nephrons and their role in the filtration process. Understand the function of the kidneys in relation to homeostatic control of bodily fluids, blood pressure and erythrocyte production. Explain how and why we control the salt content and volume of the fluid that surrounds the cells of our bodies (i.e., alkalosis, acidosis, pH).

Standard Indicators:

- AP 14.1 Describe the external and internal structure of the kidney; describe the parts of a nephron and how they are involved in the three steps in the production of urine; compare the composition of plasma and ultrafiltrate and discuss the percentages of filtered water, sodium, and glucose normally reabsorbed by the kidney tubules.
- AP 14.2 Explain the importance of the juxtaglomerular cells in the secretion of renin, which plays a central role in controlling blood pressure by controlling blood levels of angiotensin and aldosterone.
- AP 14.3 Explain the neural basis of micturition including the function of the sphincters associated with the male and female urethra.
- AP 14.4 Contrast the volume and electrolyte content of the intracellular and extracellular fluid compartments. Explain the importance of sodium, potassium, and calcium in the body's physiology.
- AP 14.5 Discuss how the volume of body fluid is determined by the balance between ingested and metabolic water on the one hand and water lost in the urine, respiration, feces, and sweating on the other hand. Describe the factors that generate the sensation of thirst. Describe how the kidneys respond to excess water intake and to dehydration; explain the role of antidiuretic hormone and of other hormones that control sodium and water absorption in the kidney.
- AP 14.6 Describe how food and metabolic processes add acid to the body fluids; recognize how chemical buffers, the lungs and the kidneys, interact in protecting the body against lethal changes of pH.

STANDARD 15: Life Cycle in the Human Body

The Reproductive System

Identify and locate major and accessory organs of the female and male reproductive systems and discuss their functions including oogenesis and spermatogenesis. Discuss the importance of hormones in the reproductive system. Define pregnancy and distinguish between pre-natal and post-natal development.

Standard Indicators:

- AP 15.1 Discuss the anatomy and physiology of the male and female reproductive systems. Compare and contrast oogenesis and spermatogenesis. Distinguish between diploid germ cells and haploid/monoploid sex cells. Describe the hormones of the gonads, their cell origins, and their functions; explain the functions of the gonadotropins FSH and LH in males and females.
- AP 15.2 Explain what is happening during the follicular, ovulatory, and luteal phases of the menstrual cycle. Describe how estradiol and progesterone released by the ovaries are responsible for the phases that the uterus goes through during the menstrual cycle.
- AP 15.3 Describe how spermatozoa move through the female reproductive tract and describe the process of fertilization.
- AP 15.4 Explain the differences among dikaryon zygote, a zygote, a morula, and a blastocyst; recognize that the blastocyst secretes human gonadotropin, which

prolongs the life of the corpus luteum and therefore, maintains levels of progesterone. Describe the process of implantation, development of the placenta, the substances that move across it, and the role of the placenta in maintaining the high levels of progesterone essential for a successful pregnancy.

AP 15.5 Describe the changes in the breast for lactation, the hormonal events that initiate milk secretion, the maintenance of milk secretion by the breasts, and the milk ejection reflex.

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